



# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PE18728PC00	<b>FOR FURTHER ACTION</b>		See Form PCT/PEA/416
International application No. PCT/EP2004/053192	International filing date (day/month/year) 01.12.2004	Priority date (day/month/year) 12.12.2003	
International Patent Classification (IPC) or national classification and IPC INV. H04Q7/38			
Applicant TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 8 sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand  07.10.2005		Date of completion of this report  17.03.2006	
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INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITYInternational application No.  
PCT/EP2004/053192

AP20 Rec'd PCT/PTO 12 JUN 2006

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-18 as originally filed

**Claims, Numbers**

1-36 received on 07.10.2005 with letter of 05.10.2005

**Drawings, Sheets**

1/10-10/10 as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/EP2004/053192

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	1-36
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	1-36
Industrial applicability (IA)	Yes: Claims	1-36
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)

PCT/EP2004/053192

Re Item I**Basis of the report**

1. The Applicant has provided with the reply letter of **05.10.2005**, received with date of **07.10.2005** amended Claims 1 to 36 in substitution to the corresponding Claims as originally filed (**Article 19(1) PCT**). These amendments are considered to comply to **Articles 19(2) and 34(2)(b) PCT**.

Re Item V**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

2. While the applicant's observations submitted with the amended claims have been carefully considered, the previously expressed opinion is nevertheless maintained for the following reasons:
3. The subject-matter of the amended **Claim 1** still cannot be considered as involving an inventive step (**Article 33(3) PCT**) for the following reasons.

Document **D2**, which is now considered to represent the most relevant state of the art, discloses, according to the essential features of **Claim 1** (applying the terminology of present **Claim 1** and the references to **D2**), method for wireless communication in a multi-user, multi-carrier communications system, using a multi-carrier resource space of least two dimensions (see for instance fig. 3; the resource space of an OFDM has 2 dimensions: a frequency and a time dimension), of which one is frequency, said multi-carrier communications system allowing a data stream to be separated into a series of parallel data streams, each of which is modulated and simultaneously transmitted with a different frequency (paragraphs [0001]-[0004]), comprising the step of:

- allocating a first resource sub-space of entire said multi-carrier resource space for communication between a first node and a second node (paragraphs [0020]-[0021], [0048]);
- said first resource sub-space comprising resources of more than one carrier

(paragraph [0022]),

- obtaining data associated with estimated radio conditions for communication between the first node and the second node (paragraphs [0023]-[0024]);

The subject-matter of **Claim 1** differs from the disclosure of **D2** in that it claims:

- a. providing access to the use of at least two pilot resource configurations, intended for different estimated node radio conditions,
- b. at least one of the at least two pilot resource configurations comprising carriers having both pilot resources and data resources;
- c. whereby the first resource sub-space is associated a first pilot resource configuration, being in agreement with pilot need for the estimated radio conditions for the second node.

The objective problem solved by these distinguishing features of Claim 1 would be regarded by the skilled person as to provide a dynamic pilot resource allocation, so as to adapt the pilot resource allocation to the different estimated radio conditions.

With regard to feature **a.**, although **D2** does not explicitly disclose to use at least two pilot resource configurations, nevertheless **D2** teaches (paragraphs [0054]-[0056]) to determine an optimum pilot allocation scheme based on the estimated node radio conditions. Moreover, it is disclosed that (paragraph [0049]) where the channel characteristics are changing rapidly, it will be necessary to re-asses the pilot allocations more often than if the characteristics are stable of a relatively long period of time. Therefore, it is submitted that there are provided not only two pilot resource configurations, but an undefined number, as many as more frequently the channel conditions change. Additionally, document **D1** discloses another example of multiple pilot resources allocation configurations, based on the channel conditions estimation (col. 2, line 58 to col. 4, line 23, col. 5, lines 17-64).

With regard to features **b.** and **c.**, it is submitted that in an OFDM system as the one

disclosed in **D2**, the pilot sub-carriers (4) are organized with data user sub-carrier (48) in a certain number of groups (resource sub-space) comprising data sub-carriers and one or more pilots sub-carrier (paragraphs [0030],[0031]), based on the estimated channel conditions. Thus, each group (resource space) may have a different pilot configuration (one or more pilots) and hence corresponds to the claimed subject-matter at points b. and c.

Therefore, the subject-matter of **Claim 1** does not involve an inventive step and does not satisfy the criterion set forth in **Article 33(3) PCT**.

4. The same considerations as made in respect of **Claim 1** are also valid for independent **Claims 26 and 35**, which contain a similar feature combination as **Claim 1** in terms of claims relating to an arrangement (apparatus). The subject-matter of **Claims 26 and 35** does therefore not involve an inventive step and does not satisfy the criterion set forth in **Article 33(3) PCT**.
5. The additional features of dependent **Claims 2 to 25, 27 to 34 and 36** do not add anything of inventive significance to **the independent Claims 1, 26 and 35** respectively because they are directly derivable from the above-mentioned prior art documents **D1 and D2** or represent standard practice.

The subject-matter of dependent **Claims 2 to 25, 27 to 34 and 36** does therefore not involve an inventive step (**Article 33(3) PCT**).

6. The formulation of the present **Claims 26 and 35** requires a revision, in order to avoid any doubts as to the category of these claims (PCT Guidelines 5.37). In this respect, some features are formulated in terms which rather correspond to features of a method (e.g. expressions such as "system allowing a data stream to be separated", etc.) while the claims are generally directed to apparatuses; a reformulation in terms of features clearly falling in the apparatus category is hence necessary (e.g. "system adapted to separate data streams", etc.).



CLAIMS AP20 Rec'd PCT/PTO 12 JUN 2006

1. Method for wireless communication in a multi-user, multi-carrier communications system (10), using a multi-carrier resource space (100) of least two dimensions, of which one is frequency, said multi-carrier communications system (10) allowing a data stream to be separated into a series of parallel data streams, each of which is modulated and simultaneously transmitted with a different frequency, comprising the step of:

- allocating a first resource sub-space (108A-F) of entire said multi-carrier resource space (100) for communication between a first node (20, 30; 30A-B) and a second node (20, 30; 30A-B);

said first resource sub-space (108A-F) comprising resources of more than one carrier,

**characterised by** the further steps of:

- obtaining data associated with estimated radio conditions for communication between the first node (20, 30; 30A-B) and the second node (20, 30; 30A-B),

- providing access to the use of at least two pilot resource configurations, intended for different estimated node radio conditions,

at least one of the at least two pilot resource configurations comprising carriers having both pilot resources and data resources;

whereby the first resource sub-space (108A-F) is associated a first pilot resource configuration, being in agreement with pilot need for the estimated radio conditions for the second node (20, 30; 30A-B).

2. Method according to claim 1, **characterised in that** the entire multi-carrier resource space (100) being divided into parts (110A-D) having different pilot resource configurations;

whereby the step of allocating comprises the step of selecting the first resource sub-space (108A-F) in a part having a pilot resource configuration suitable for the estimated radio conditions for the second node (20, 30; 30A-B).

3. Method according to claim 2, **characterised by** the further steps of:
- selecting, if no resource space part (110A-D) having a pilot resource configuration suitable for the estimated radio conditions for the second node (20, 30; 30A-B) is available, an arbitrary first multi-carrier resource sub-space; and
  - adapting the pilot resource configuration within the first multi-carrier resource sub-space to suit the estimated radio conditions for the second node (20, 30; 30A-B).
4. Method according to claim 1, **characterised by** the steps of:
- selecting the first multi-carrier resource sub-space; and
  - adapting the pilot resource configuration within the first multi-carrier resource sub-space to suit the estimated radio conditions for the second node (20, 30; 30A-B) after the step of selecting.
5. Method according to any of the claims 1 to 4, **characterised in that** the multi-carrier resource space (100) has a time dimension.
6. Method according to any of the claims 1 to 5, **characterised in that** the multi-carrier resource space (100) has a code dimension.
7. Method according to any of the claims 1 to 6, **characterised in that** the multi-carrier resource space (100) has a spatial dimension.
8. Method according to any of the claims 1 to 7, **characterised in that** the step of obtaining in turn comprises the step of estimating a set of estimated radio conditions.
9. Method according to claim 8, **characterised in that** the set of estimated radio conditions comprises at least Doppler conditions.



10. Method according to claim 8 or 9, **characterised in that** the set of estimated radio conditions comprises at least delay spread conditions.

5 11. Method according to any of the claims 8 to 10, **characterised in that** the step of estimating is based on position and/or velocity information concerning the second node (20, 30; 30A-B).

12. Method according to any of the claims 1 to 11, **characterised in that** the step of obtaining comprises the step of receiving instructions and/or suggestions about preferred pilot resource configuration.

13. Method according to any of the claims 1 to 12, **characterised in that** the first node (20, 30; 30A-B) is selected from the group of:

15 user equipment;  
mobile station;  
base station;  
access point (20); and  
relay.

20 14. Method according to any of the claims 1 to 13, **characterised in that** the second node (20, 30; 30A-B) is selected from the group of:

user equipment;  
mobile station;  
base station;  
access point (20); and  
relay.

30 15. Method according to any of the claims 1 to 14, **characterised in that** resources of the first resource sub-space are allocated for downlink communication (22; 22A-B).

16. Method according to claim 15, **characterised in that** the step of obtaining data associated with estimated radio conditions for the second node (20, 30; 30A-B) is performed in a base station or access point (20).

17. Method according to claim 16, **characterised by** the further step of transferring data characterising the first pilot resource configuration from the base station or access point (20) to the second node (20, 30; 30A-B).

18. Method according to any of the claims 1 to 12, **characterised in that** resources of the first resource sub-space are allocated for uplink communication (24; 24A-B).

19. Method according to claim 18, **characterised in that** the step of obtaining data associated with estimated radio conditions for the second node (30; 30A-B) is performed in a base station or access point (20), followed by the step of transferring the data associated with estimated radio conditions for the second node (30; 30A-B) to the second node (30; 30A-B).

20. Method according to claim 18, **characterised in that** the step of obtaining data associated with estimated radio conditions for the second node (30; 30A-B) is performed in the second node (30; 30A-B).

21. Method according to claim 20, **characterised by** the further step of transferring data characterising the first pilot resource configuration from the second node (30; 30A-B) to the first node (20, 30; 30A-B).

22. Method according to any of the claims 1 to 21, **characterised by** refraining from transmitting pilots in areas of the entire multi-carrier resource space (100) not being allocated.

23. Method according to any of the claims 1 to 22, **characterised in that** the wireless communication utilises OFDM.

24. Method according to any of the claims 1 to 23, **characterised in that** the available at least two pilot resource configurations comprises different distribution patterns of pilot symbols in the multi-carrier resource space (100).

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25. Method according to claim 24, **characterised in that** the available at least two pilot resource configurations further comprises transmission of pilot symbols with differing intensity.

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26. Arrangement being or comprising a first node (20, 30; 30A-B) of a multi-user, multi-carrier wireless communications system (10) using a multi-carrier resource space of least two dimensions, of which one is frequency, said multi-carrier communications system allowing a data stream to be separated into a series of parallel data streams, each of which is modulated and simultaneously transmitted with a different frequency, the first node (20, 30; 30A-B) comprising:

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- means (25) for allocating a first resource sub-space (108A-F) of entire said multi-carrier resource space (100) for communication between a first node (20, 30; 30A-B) and a second node (20, 30; 30A-B);

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said first resource sub-space (108A-F) comprising resources of more than one carrier,

**characterised in that** the first node (20, 30; 30A-B) further comprises:

- means (28, 29, 38, 39) for obtaining data associated with estimated radio conditions for communication between the first node (20, 30; 30A-B) and a second node (20, 30; 30A-B), and

- means (26) for providing access to the use of at least two pilot resource configurations, intended for different estimated node radio conditions,

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at least one of the at least two pilot resource configurations comprising carriers having both pilot resources and data resources;

whereby the first resource sub-space comprises a first pilot resource configuration, being in agreement with pilot need for the estimated radio conditions for the second node (20, 30; 30A-B).

27. Arrangement according to claim 26, **characterised in that** the entire multi-carrier resource space (100) being divided into parts (110A-D) having different pilot resource configurations;

5           whereby the means (25) for allocating being arranged for selecting the first resource sub-space in a part having a pilot resource configuration suitable for the estimated radio conditions for the second node (20, 30; 30A-B).

28. Arrangement according to claim 26, **characterised in that** the first node (20, 30; 30A-B) further comprises:

          means for selecting the first multi-carrier resource sub-space; and

          means for adapting the pilot resource configuration within the first multi-carrier resource sub-space to suit the estimated radio conditions for the  
15       second node (20, 30; 30A-B), the means for adapting being connected to an output of the means for selecting.

29. Arrangement according to any of the claims 26 to 28, **characterised in that** the first node (20, 30; 30A-B) further comprises:

20           means for transferring data characterising the first pilot resource configuration from the first node (20, 30; 30A-B) to the second node (20, 30; 30A-B).

30. Arrangement according to any of the claims 26 to 29, **characterised in that** the means (28, 29, 38, 39) for obtaining data associated with estimated radio conditions for the second node (20, 30; 30A-B) in turn comprises a receiver for receiving instructions and/or suggestions about preferred pilot resource configuration from the second node (20, 30; 30A-B).

30       31. Arrangement according to any of the claims 26 to 30, **characterised in that** the arrangement is a wireless communications system (10).

32. Arrangement according to any of the claims 26 to 31, **characterised in that** the arrangement utilises OFDM.

33. Arrangement according to any of the claims 26 to 32, **characterised in that** the first node (20, 30; 30A-B) is selected from the group of:

user equipment;  
mobile station;  
base station;  
access point (20); and  
relay.

34. Arrangement according to any of the claims 26 to 33, **characterised in that** the second node (20, 30; 30A-B) is selected from the group of:

user equipment;  
mobile station;  
base station;  
access point (20); and  
relay.

35. User equipment (30) capable of being connected to a multi-user, multi-carrier wireless communications system (10) using a multi-carrier resource space (100) of least two dimensions, of which one is frequency, said multi-carrier communications system allowing a data stream to be separated into a series of parallel data streams, each of which is modulated and simultaneously transmitted with a different frequency, comprising:

- means (35) for communication between the user equipment (30) and a node (20, 30; 30A-B) utilising a first resource sub-space (108A-F) of entire said multi-carrier resource space (100);

said first resource sub-space (108A-F) comprising resources of more than one carrier,

**characterised in that**

the first resource sub-space (108A-F) comprises a first pilot resource configuration, out of a set of at least two different pilot resource configurations,

at least one of the at least two pilot resource configurations comprising carriers having both pilot resources and data resources; and

whereby the first pilot resource configuration being in agreement with pilot need for estimated radio conditions for the user equipment (30).

36. User equipment according to claim 35, **characterised by:**

- receiver for receiving data characterising the first pilot resource configuration from the node (20, 30; 30A-B);

- means (36) for channel estimation, connected to the receiver,

whereby the means for channel estimation is arranged to perform channel estimation based on the received data characterising the first pilot resource configuration.

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